

10

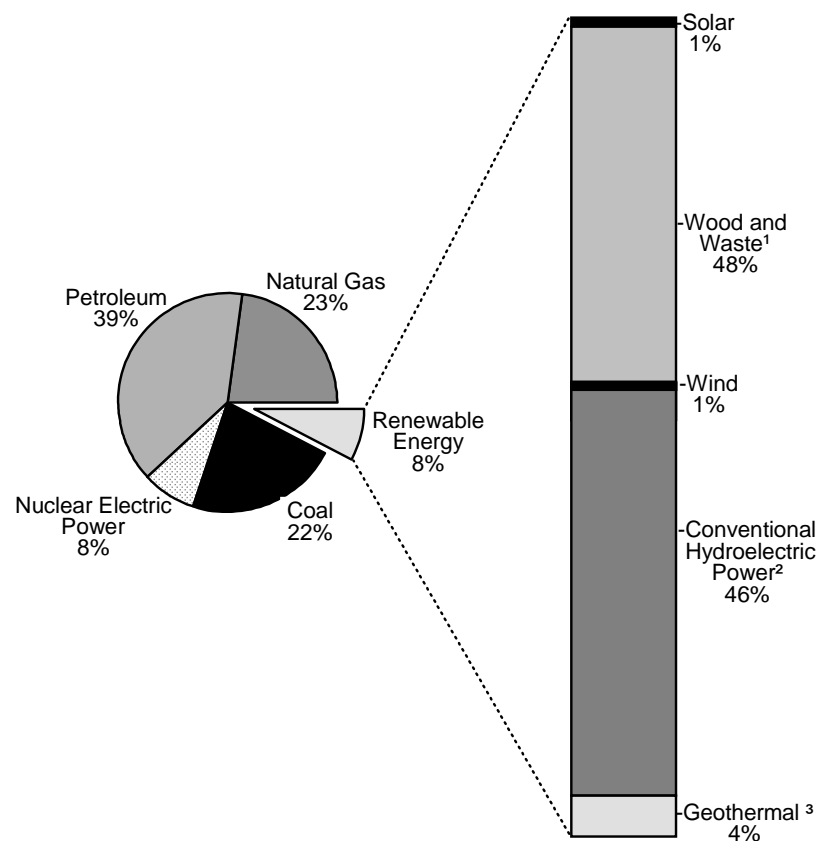
Renewable Energy



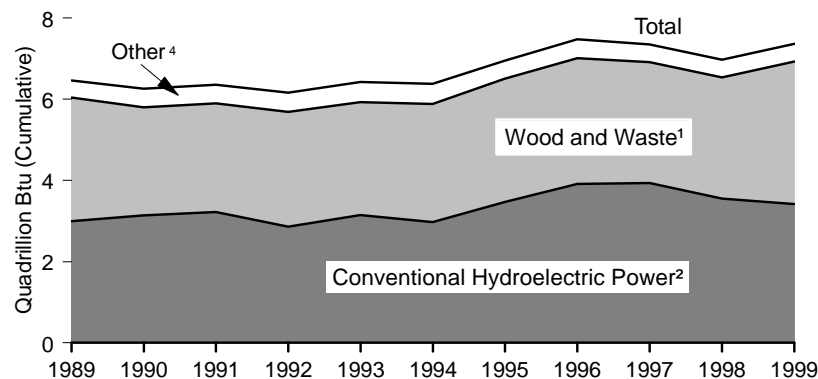
Grand Coulee Dam, Washington State. Source: U.S. Bureau of Reclamation.

Figure 10.1 Renewable Energy Consumption by Source

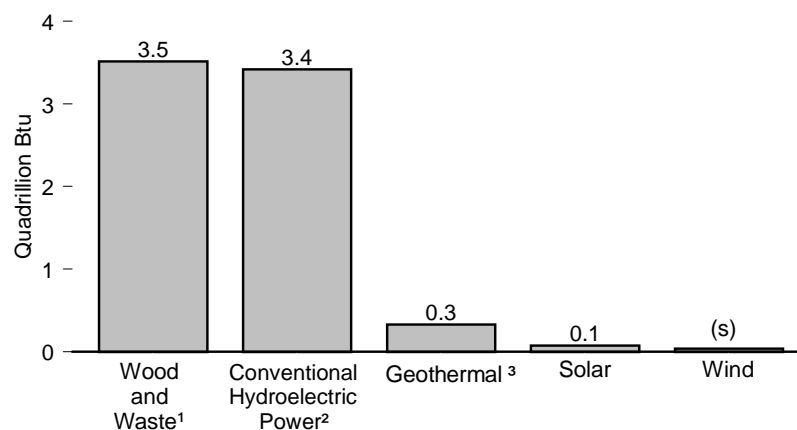
Renewable Energy as Share of Total Energy, 1999



Renewable Energy Consumption by Source, 1989-1999



Renewable Energy Consumption by Source, 1999



¹ Includes ethanol blended into motor gasoline.

² Includes electricity net imports from Canada that are derived from hydroelectric power.

³ Includes electricity imports from Mexico that are derived from geothermal energy.

⁴ Geothermal, solar, and wind.

(s) = Less than 0.05 quadrillion Btu.

Note: Because vertical scales differ, graphs should not be compared.

Sources: Tables 1.3 and 10.1.

Table 10.1 Renewable Energy Consumption by Source, 1989-1999
(Quadrillion Btu)

Year	Wood and Waste ¹	Geothermal ²	Conventional Hydroelectric Power ^{3,4}	Solar ⁵	Wind ⁶	Total
1989	R3.050	R0.338	R2.999	R0.059	R0.024	R6.470
1990	R2.665	R0.359	R3.140	0.063	R0.032	R6.260
1991	R2.679	R0.368	R3.222	0.066	R0.032	R6.367
1992	R2.826	0.379	2.863	0.068	0.030	R6.167
1993	R2.782	0.393	3.147	0.071	0.031	R6.424
1994	R2.914	0.395	2.971	0.072	0.036	R6.387
1995	R3.044	0.339	3.474	0.073	0.033	R6.963
1996	R3.104	0.352	R3.915	0.075	0.035	R7.482
1997	R2.982	R0.328	R3.940	0.074	R0.034	R7.358
1998	R2.991	R0.335	R3.552	0.074	R0.031	R6.984
1999 ^E	3.514	0.327	3.417	0.076	0.038	7.373

¹ Wood, wood waste, black liquor, red liquor, spent sulfite liquor, pitch, wood sludge, peat, railroad ties, utility poles, municipal solid waste, landfill gas, methane, digester gas, liquid acetonitrile waste, tall oil, waste alcohol, medical waste, paper pellets, sludge waste, solid byproducts, tires, agricultural byproducts, closed looped biomass, fish oil, and straw.

² Includes electricity imports from Mexico that are derived from geothermal energy. Includes grid-connected electricity, and geothermal heat pump and direct use energy. Excludes shaft power and remote electrical power.

³ Hydroelectricity generated by pumped storage is not included in renewable energy.

⁴ Includes electricity net imports from Canada that are derived from hydroelectric power.

⁵ Includes solar thermal and photovoltaic energy.

⁶ Includes only grid-connected electricity.

R=Revised. E=Estimated.

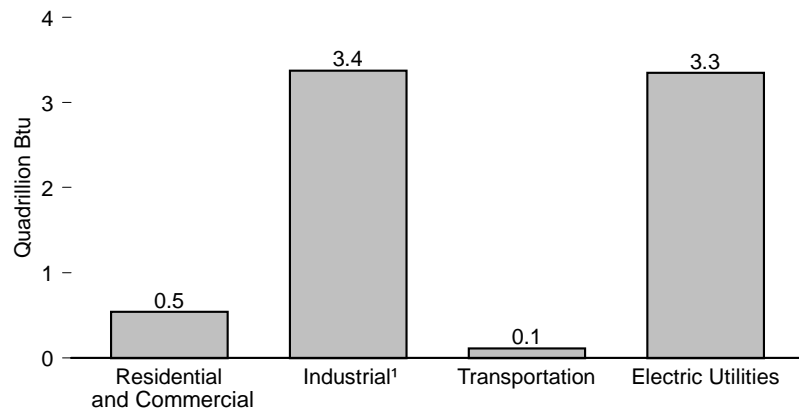
Note: Totals may not equal sum of components due to independent rounding.

Web Page: <http://www.eia.doe.gov/fuelrenewable.html>.

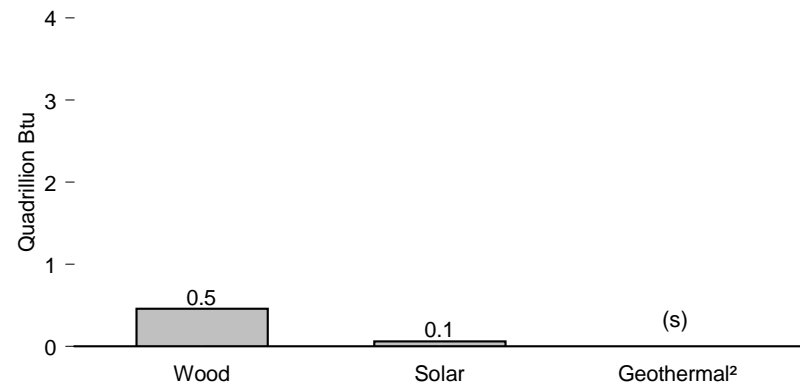
Sources: • 1989—Energy Information Administration (EIA) estimates. • 1990-1993—EIA, *Renewable Energy Annual*, annual reports. • 1994-1998—EIA, *Renewable Energy Annual 1999* (December 1999). • 1999—EIA estimates.

Figure 10.2 Renewable Energy Consumption by Sector, 1999

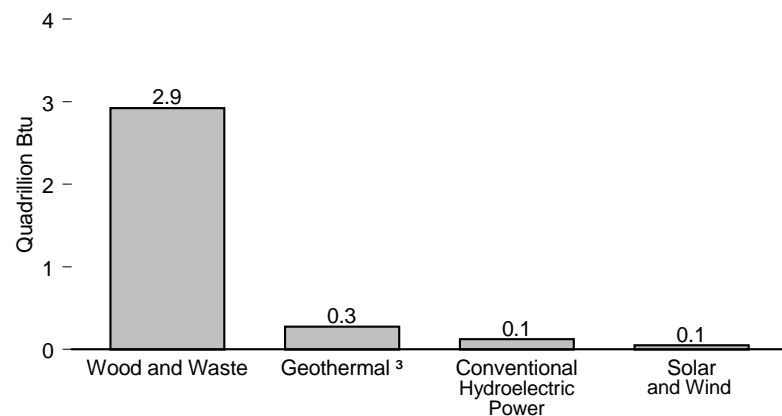
By Sector



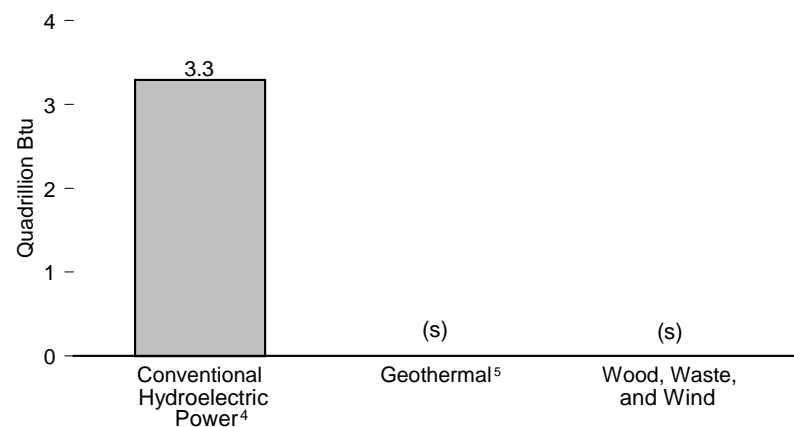
Residential and Commercial Sector



Industrial Sector



Electric Utilities



¹ Generation of electricity by nonutility power producers is included in the industrial sector, not the electric utility sector. Covers facilities of 1 megawatt or greater capacity.

² Geothermal heat pump and direct energy use.

³ Geothermal electricity generation, heat pump, and direct energy use.

⁴ Includes electricity net imports from Canada that are derived from hydroelectric power.

⁵ Includes electricity imports from Mexico that are derived from geothermal energy.

(s) = Less than 0.05 quadrillion Btu.

Source: Table 10.2.

Table 10.2 Renewable Energy Consumption by Sector, 1989-1999
(Quadrillion Btu)

Year	Residential and Commercial				Industrial ¹						Trans- portation	Electric Utilities ²					Total
	Wood ³	Geo- thermal ⁴	Solar ⁵	Total	Wood and Waste ⁶	Geo- thermal ⁷	Conventional Hydroelectric Power ⁸	Solar	Wind	Total	Alcohol Fuels ⁹	Wood and Waste ⁶	Geo- thermal ¹⁰	Conventional Hydroelectric Power ^{8,11}	Solar and Wind	Total	
1989	R0.952	0.008	0.053	R1.012	R2.007	R0.122	R0.091	R0.007	R0.024	R2.250	0.071	0.020	0.208	2.908	(s)	3.137	R6.470
1990	R0.618	0.008	0.056	R0.682	R1.944	R0.159	R0.101	0.007	R0.032	R2.242	0.082	R0.022	0.192	3.039	(s)	3.253	R6.260
1991	R0.652	0.009	0.058	R0.719	R1.940	R0.174	R0.100	0.008	R0.032	R2.254	0.065	0.021	0.185	3.123	(s)	R3.330	R6.367
1992	R0.687	0.010	0.060	R0.756	R2.040	0.182	0.098	0.008	0.030	R2.357	R0.078	0.022	0.188	2.766	(s)	R2.976	R6.167
1993	0.592	0.010	0.062	0.664	R2.082	0.206	0.119	0.009	0.031	R2.447	0.088	R0.021	0.177	3.028	(s)	3.225	R6.424
1994	0.582	0.010	0.064	0.656	R2.214	0.214	0.136	0.009	0.036	R2.610	0.097	R0.021	0.170	2.834	(s)	3.024	R6.387
1995	0.641	0.011	0.065	0.717	R2.281	0.210	0.152	0.008	0.033	R2.685	0.104	0.017	0.118	3.322	(s)	3.457	R6.963
1996	0.644	0.012	0.066	0.722	R2.366	0.217	0.171	0.009	0.035	R2.798	0.074	0.020	0.123	R3.744	(s)	R3.888	R7.482
1997	R0.480	0.013	0.065	R0.558	R2.385	R0.200	0.185	0.009	R0.034	2.813	0.097	R0.021	0.115	R3.754	(s)	R3.890	R7.358
1998	R0.424	0.015	0.065	R0.503	R2.441	R0.211	R0.151	R0.009	R0.031	R2.844	0.105	R0.021	R0.110	R3.401	(s)	R3.532	R6.984
1999 ^E	0.461	0.015	0.063	0.539	2.922	0.276	0.125	0.013	0.038	3.373	0.112	0.020	0.036	3.292	(s)	3.349	7.373

¹ Nonutility power producers' use of renewable energy to produce electricity and useful thermal output is included in the industrial sector, not the electric utility sector. Covers facilities of 1 megawatt or greater capacity.

² For Btu conversion rates, see Appendix Table A6.

³ Wood.

⁴ Geothermal heat pump and direct use energy.

⁵ The solar thermal component of 0.06 quadrillion Btu for residential and commercial use is calculated by presuming an overall efficiency of 50 percent for all three categories of solar thermal collectors (low temperature, medium temperature, and high temperature), a 1,500-Btu per square foot average daily insolation, and the potential thermal energy production from the 219 million square feet of solar thermal collectors produced between 1980 and 1999. This is a simplified approach since low-temperature and high-temperature collectors have been rated at more than 50 percent efficient and medium-temperature collectors are generally less than 50 percent efficient. Included also is a very small amount of photovoltaic solar energy.

⁶ Wood, wood waste, black liquor, red liquor, spent sulfite liquor, pitch, wood sludge, peat, railroad ties,

utility poles, municipal solid waste, landfill gas, methane, digester gas, liquid acetonitrile waste, tall oil, waste alcohol, medical waste, paper pellets, sludge waste, solid byproducts, tires, agricultural byproducts, closed looped biomass, fish oil, and straw.

⁷ Geothermal electricity generation, heat pump, and direct use energy.

⁸ Hydroelectricity generated by pumped storage is not included in renewable energy.

⁹ Ethanol blended into motor gasoline.

¹⁰ Includes electricity imports from Mexico that are derived from geothermal energy.

¹¹ Includes electricity net imports from Canada that are derived from hydroelectric power.

R=Revised. E=Estimated. (s)=Less than 0.0005 quadrillion Btu.

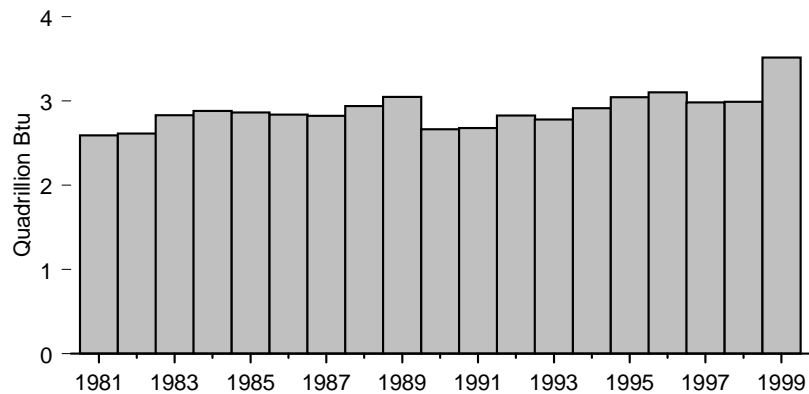
Note: Totals may not equal sum of components due to independent rounding.

Web Page: <http://www.eia.doe.gov/fuelrenewable.html>.

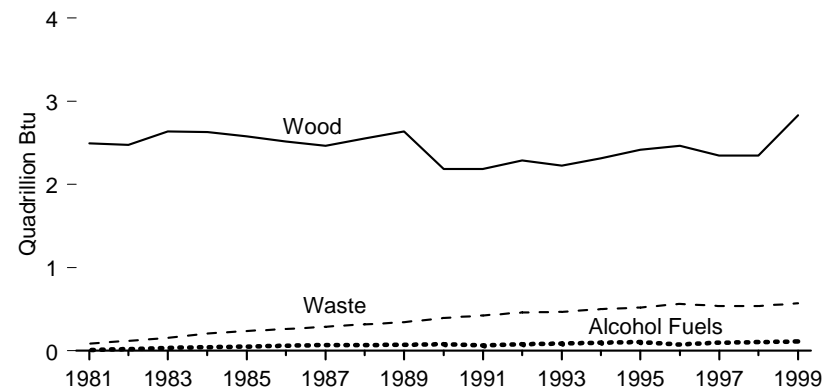
Sources: • 1989—Energy Information Administration (EIA) estimates. • 1990-1993—EIA, *Renewable Energy Annual*, annual reports. • 1994-1998—EIA, *Renewable Energy Annual 1999* (December 1999). • 1999—EIA estimates.

Figure 10.3 Wood and Waste Energy and Alcohol Fuels Consumption Estimates

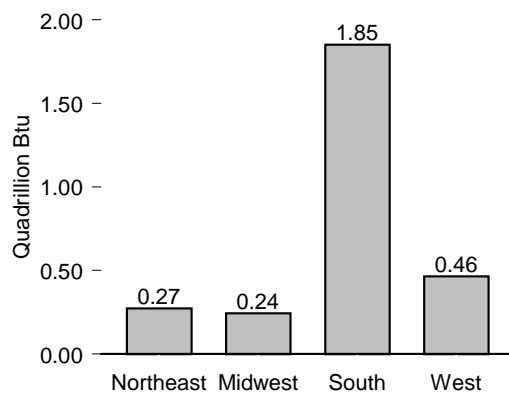
Total Wood and Waste Energy and Alcohol Fuels, 1981-1999



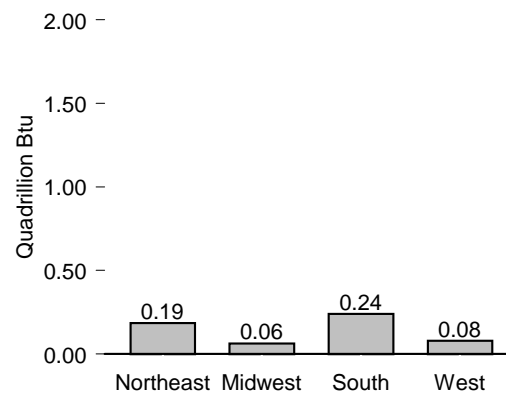
Wood and Waste Energy and Alcohol Fuels by Type, 1981-1999



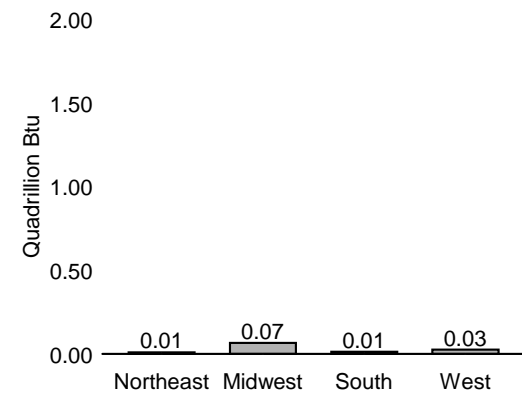
Wood Energy by Census Region, 1999



Waste Energy by Census Region, 1999



Alcohol Fuels¹ by Census Region, 1999



¹ Ethanol blended into motor gasoline.

Notes: • Not all data were available for 1985, 1986, and 1988; therefore, values were interpolated. • Beginning in 1989, includes expanded coverage of nonutility consumption.

• See Appendix D for Census regions. • Because vertical scales differ, graphs should not be compared.

Source: Table 10.3.

Table 10.3 Wood and Waste Energy and Alcohol Fuels Consumption Estimates by Type and Census Region, 1981-1999
(Trillion Btu)

Year	Wood ¹					Waste ²					Alcohol Fuels ³					Total
	North-east	Mid-west	South	West	Total	North-east	Mid-west	South	West	Total	North-east	Mid-west	South	West	Total	
1981	395	335	1,349	416	2,495	16	5	37	30	88	(s)	4	1	2	7	2,590
1982	358	343	^R 1,391	385	^R 2,477	20	13	50	36	^R 119	(s)	11	4	4	19	^R 2,615
1983	380	323	1,526	411	^R 2,639	36	17	56	48	157	(s)	22	8	5	35	^R 2,831
1984	^R 348	^R 340	^R 1,480	^R 460	^R 2,629	39	21	57	91	208	(s)	25	13	5	43	^R 2,880
1985 ⁴	350	386	1,374	464	2,576	46	30	74	85	235	(s)	29	17	5	51	2,862
1986 ⁴	352	432	1,266	468	2,518	53	38	91	80	262	(s)	34	22	4	60	2,840
1987	^R 354	^R 479	^R 1,160	^R 472	^R 2,465	60	47	108	74	289	(s)	38	26	4	^R 68	^R 2,822
1988 ⁴	396	519	1,168	469	2,552	72	56	127	63	318	(s)	38	26	6	70	2,940
1989	^R 437	^R 559	^R 1,175	^R 464	^R 2,635	84	64	145	51	344	(s)	38	26	7	71	^R 3,050
1990	^R 260	^R 335	^R 1,081	^R 513	^R 2,188	119	89	114	73	395	(s)	55	17	10	82	^R 2,665
1991	^R 228	^R 295	^R 1,187	^R 477	^R 2,188	^R 133	^R 98	^R 108	87	426	(s)	45	11	9	65	^R 2,679
1992	^R 269	^R 291	^R 1,255	^R 474	^R 2,288	148	84	128	100	460	(s)	55	13	10	^R 78	^R 2,826
1993	277	222	^R 1,404	324	^R 2,226	151	85	130	102	468	(s)	^R 62	^R 15	11	88	^R 2,782
1994	284	228	^R 1,468	335	^R 2,314	169	59	204	71	503	(s)	^R 69	16	12	97	^R 2,914
1995	^R 368	^R 289	^R 1,100	^R 660	^R 2,418	172	58	219	73	521	(s)	^R 73	^R 17	^R 13	104	^R 3,044
1996	^R 267	^R 254	1,523	^R 422	^R 2,465	187	63	235	80	565	7	43	8	16	74	^R 3,104
1997	^R 253	^R 213	^R 1,488	^R 394	^R 2,348	191	61	213	72	538	9	56	11	21	97	^R 2,982
1998	^R 237	^R 206	^R 1,513	^R 389	^R 2,346	^R 185	63	^R 217	^R 75	^R 540	^R 9	61	12	23	105	^R 2,991
1999	273	243	1,852	464	2,832	186	64	241	80	571	10	65	12	25	112	3,514

¹ Wood, wood waste, black liquor, red liquor, spent sulfite liquor, pitch, wood sludge, peat, railroad ties, and utility poles. Beginning in 1989, includes expanded coverage of nonutility consumption (see Table 8.4).

² Municipal solid waste, landfill gas, methane, digester gas, liquid acetonitrile waste, tall oil, waste alcohol, medical waste, paper pellets, sludge waste, solid byproducts, tires, agricultural byproducts, closed looped biomass, fish oil, and straw. Beginning in 1989, includes expanded coverage of nonutility consumption (see Table 8.4).

³ Ethanol blended into motor gasoline.

⁴ Not all data were available; therefore, values were interpolated.

R=Revised. (s)=Less than 0.5 trillion Btu.

Notes: • See Appendix D for Census regions. • Totals may not equal sum of components due to independent rounding.

Web Page: <http://www.eia.doe.gov/fuelrenewable.html>.

Sources: • **1981-1983, Wood**—EIA, *Estimates of U.S. Wood Energy Consumption, 1980-1983* (November 1984), Tables ES1 and ES2. • **1981-1983 Waste and Alcohol Fuels, and 1984 Data**—EIA, Office of Coal, Nuclear, Electric and Alternate Fuels, unpublished data. • **1987**—EIA, *Estimates of Biofuels Consumption in the United States During 1987*, Tables ES1 and ES2. • **1989—Wood, Industrial Sector**: American Paper Institute, *Fact Sheet on 1990 Energy Use in the U.S. Pulp and Paper Industry* (July 31, 1991). **All Other Data**: EIA, *Estimates of U.S. Biofuels Consumption 1989* (April 1991), Table ES1. • **1990—Wood, Industrial Sector**: American Paper Institute, *Fact Sheet on 1990 Energy Use in the U.S.*

Pulp and Paper Industry (July 1991). **Wood, Residential Sector**: EIA, "1990 Residential Energy Consumption Survey." **Waste**: EIA, *Estimates of U.S. Biofuels Consumption 1990* (October 1991), Table ES1. **Alcohol Fuels**: U.S. Department of Transportation, *Monthly Motor Fuel Reported by States*, FHWA-PL-92-011 (September 1991); U.S. Department of Treasury, Bureau of Alcohol, Tobacco, and Firearms, *Monthly Distilled Spirits Report*, Report Symbol 76 (June 1991), *Alcohol Fuels Report*, internal quarterly report (September 1991), and EIA, *Petroleum Supply Monthly*, various issues. • **1991 and 1992**: EIA, *Estimates of U.S. Biomass Energy Consumption 1992* (May 1994). • **1993-1999—Wood, Residential Sector**: EIA, Form EIA-457, "1993 Residential Energy Consumption Survey," extrapolations from "1993 Residential Energy Consumption Survey" for 1994 through 1996 estimates, and "1997 Residential Energy Consumption Survey" for 1997, and extrapolations for 1998 and 1999. **Wood, Commercial Sector**: EIA, Office of Coal, Nuclear, Electric and Alternate Fuels (CNEAF), estimates. **Wood, Industrial Sector**: EIA, CNEAF, estimates derived from information from other government agencies, trade journals, industry association reports, Form EIA-846, "1991 Manufacturing Energy Consumption Survey," and Form EIA-846, "1994 Manufacturing Energy Consumption Survey." **Wood, Electric Utility**: EIA, Form EIA-861, "Annual Electric Utility Report," and Form EIA-759, "Monthly Power Plant Report." **Waste**: Government Advisory Associates, *Resource Recovery Yearbook*, and *Methane Recovery Yearbook*, and CNEAF estimates. **Alcohol Fuels**: EIA, Form EIA-819M, "Monthly Oxygenate Telephone Report."

Figure 10.4 Wood Energy Consumption Estimates

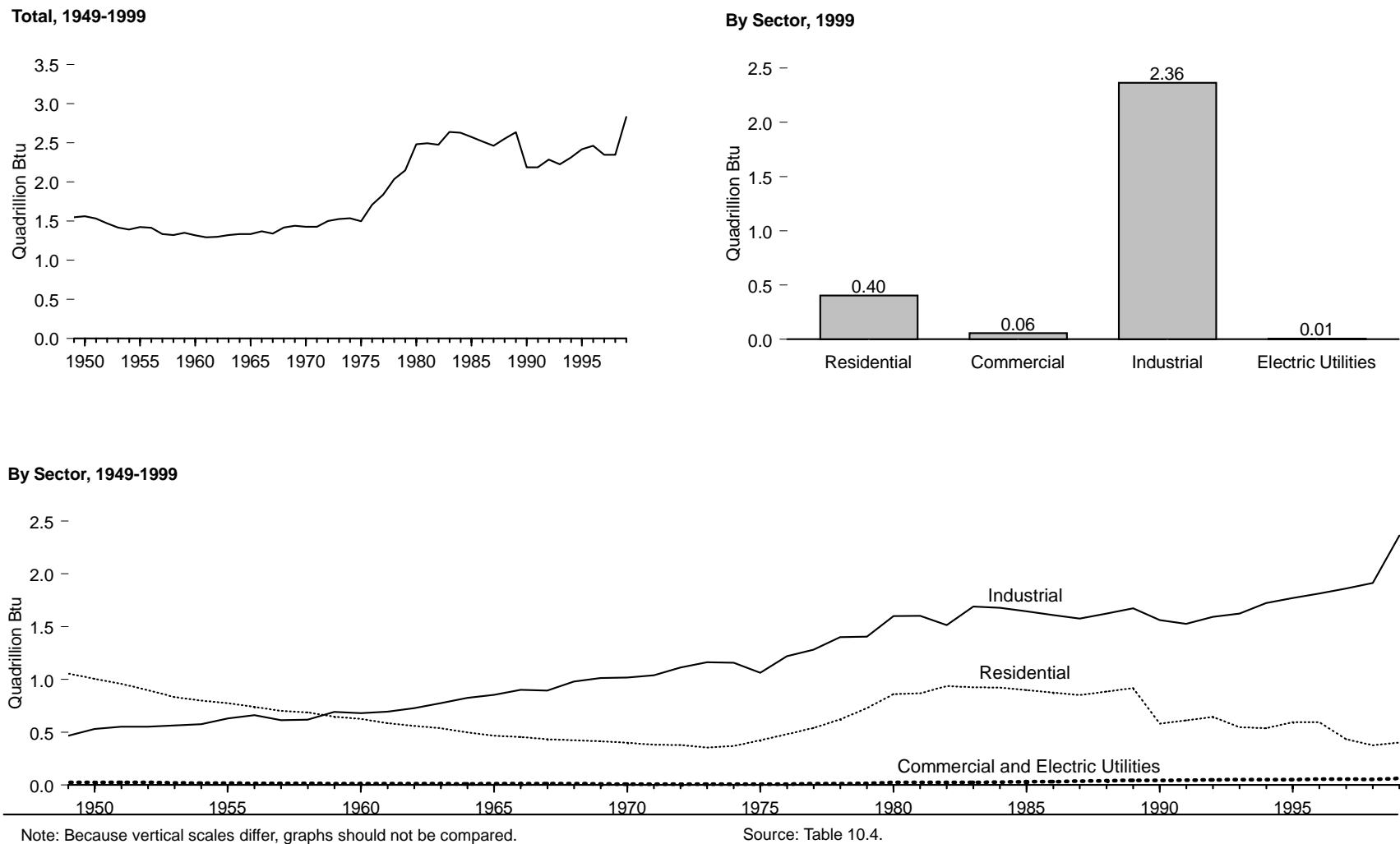


Table 10.4 Wood Energy Consumption Estimates by Sector, 1949-1999
(Trillion Btu)

Year	Residential	Commercial	Industrial	Electric Utilities	Total
1949	1,055	20	468	6	1,549
1950	1,006	19	532	5	1,562
1951	958	18	553	5	1,535
1952	899	17	552	6	1,474
1953	832	16	566	5	1,419
1954	800	15	576	3	1,394
1955	775	15	631	3	1,424
1956	739	14	661	2	1,416
1957	702	13	616	2	1,334
1958	688	13	620	2	1,323
1959	647	12	692	2	1,353
1960	627	12	680	2	1,320
1961	587	11	695	1	1,295
1962	560	11	728	1	1,300
1963	537	10	775	1	1,323
1964	499	9	827	2	1,337
1965	468	9	855	3	1,335
1966	455	9	902	3	1,369
1967	434	8	895	3	1,340
1968	426	8	982	4	1,419
1969	415	8	1,014	3	1,440
1970	401	8	1,019	1	1,429
1971	382	7	1,040	1	1,430
1972	380	7	1,113	1	1,501
1973	354	7	1,165	1	1,527
1974	371	7	1,159	1	1,538
1975	425	8	1,063	(s)	1,497
1976	482	9	1,220	1	1,711
1977	542	10	1,281	3	1,837
1978	622	12	1,400	2	2,036
1979	728	14	1,405	3	2,150
1980	860	21	1,600	3	2,483
1981	869	21	1,602	3	2,495
1982	937	22	1,516	2	R2,477
1983	925	22	1,690	R2	R2,639
1984	923	22	1,679	R5	R2,629
1985	1899	124	1,645	8	12,576
1986	1876	127	1,610	5	12,518
1987	852	129	1,576	R8	R12,465
1988	1885	132	1,625	10	12,552
1989	918	134	1,673	R10	R12,635
1990	581	137	1,562	R8	R12,188
1991	613	139	1,528	R8	R12,188
1992	645	142	1,593	R8	R12,288
1993	548	44	1,625	R9	R2,226
1994	537	45	1,724	R8	R2,314
1995	596	45	1,771	R7	R2,418
1996	595	49	1,813	R8	R2,465
1997	433	R47	1,860	R8	R2,348
1998	R377	R47	1,914	R7	R2,346
1999	404	57	2,364	7	2,832

¹ No data were available, therefore, values were interpolated.

R=Revised. (s)=Less than 0.5 trillion Btu.

Note: Totals may not equal sum of components due to independent rounding.

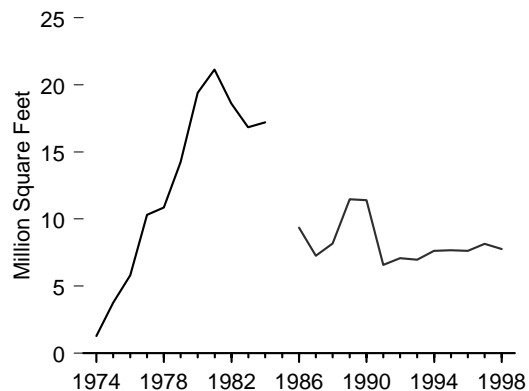
Web Page: <http://www.eia.doe.gov/fuelrenewable.html>.

Sources: • **1949-1980** Calculated from Energy Information Administration (EIA), *Estimates of U.S. Wood Energy Consumption from 1949 to 1981*, Table A2, and EIA, *Annual Energy Review 1999*, Table 8.3. Plotted at yearly intervals. • **1980:** EIA, *Estimates of U.S. Wood Energy Consumption 1980-1983*, Table ES1, and calculation from *Annual Energy Review 1999*, Table 8.3. • **1981-1983:** EIA, *Estimates of U.S. Wood Energy Consumption, 1980-1983* (November 1984), Tables ES1 and ES2. • **1989-Industrial Sector:** American Paper Institute, *Fact Sheet on 1990 Energy Use in the U.S. Pulp and Paper Industry* (July 31, 1991). • **All Other Data:** EIA, *Estimates of U.S. Biofuels Consumption 1989*

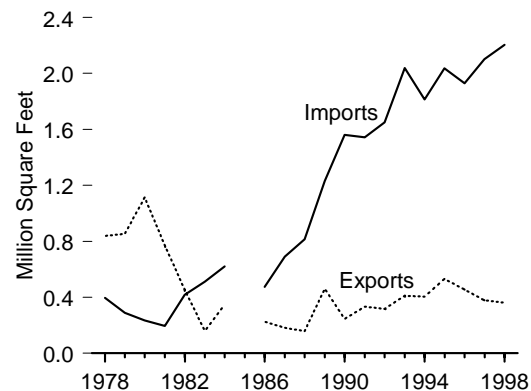
(April 1991), Table ES1. • **1990-Industrial Sector:** American Paper Institute, *Fact Sheet on 1990 Energy Use in the U.S. Pulp and Paper Industry* (July 1991). • **Residential Sector:** EIA, "1990 Residential Energy Consumption Survey." • **1991 and 1992:** EIA, *Estimates of U.S. Biomass Energy Consumption 1992* (May 1994). • **1993-1998:** EIA, Form EIA-457, "1993 Residential Energy Consumption Survey," extrapolations from "1993 Residential Energy Consumption Survey" for 1994 through 1996 estimates, and "1997 Residential Energy Consumption Survey" for 1997, and extrapolations for 1998 and 1999. • **Commercial Sector:** EIA, Office of Coal, Nuclear, Electric and Alternate Fuels (CNEAF), estimates. • **Industrial Sector:** EIA, CNEAF, estimates derived from information from other government agencies, trade journals, industry association reports, Form EIA-846, "1991 Manufacturing Energy Consumption Survey," and Form EIA-846, "1994 Manufacturing Energy Consumption Survey." • **Electric Utility:** EIA, Form EIA-861, "Annual Electric Utility Report," and Form EIA-759, "Monthly Power Plant Report."

Figure 10.5 Solar Thermal Collector Shipments by Type, Price, and Trade

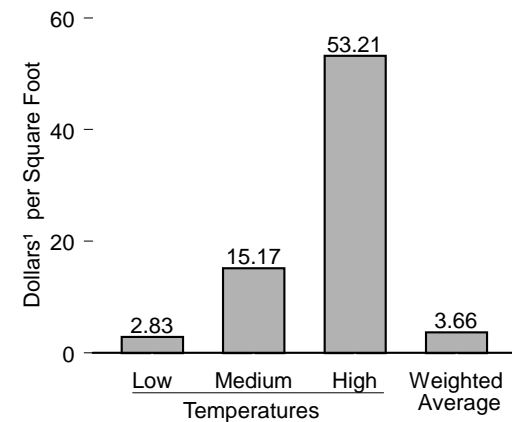
Total Shipments, 1974-1984 and 1986-1998



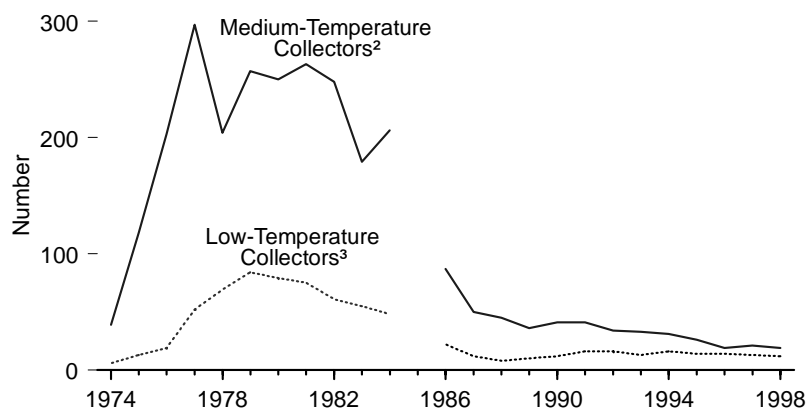
Trade, 1978-1984 and 1986-1998



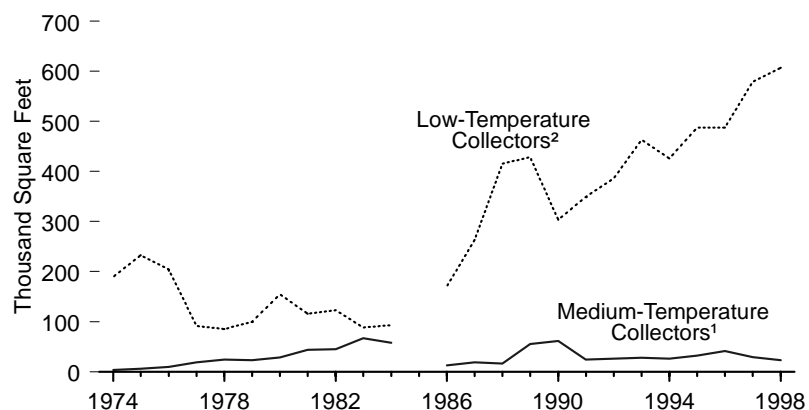
Prices, 1998



Number of U.S. Manufacturers, 1974-1984 and 1986-1998



Average Annual Shipments per Manufacturer, 1974-1984 and 1986-1998



¹ Nominal dollars.

² Collectors that generally operate in the temperature range of 140 degrees Fahrenheit to 180 degrees Fahrenheit but can also operate at temperatures as low as 110 degrees Fahrenheit.

³ Collectors that generally operate at temperatures below 110 degrees Fahrenheit.

Notes: • Data were not collected for 1985. • Medium-temperature collectors include special collectors. • Because vertical scales differ, graphs should not be compared.

Source: Table 10.5.

Table 10.5 Solar Thermal Collector Shipments by Type, Price, and Trade, 1974-1998
(Thousand Square Feet, Except as Noted)

Year	Low-Temperature Collectors ¹				Medium-Temperature Collectors ²				High-Temperature Collectors ³		Total Shipments ⁴		Imports	Exports
	Number of U.S. Manufacturers	Quantity Shipped	Shipments per Manufacturer	Price ⁵ (dollars per square foot)	Number of U.S. Manufacturers	Quantity Shipped	Shipments per Manufacturer	Price ⁵ (dollars per square foot)	Quantity Shipped	Price ⁵ (dollars per square foot)	Quantity Shipped	Price ⁵ (dollars per square foot)		
1974	6	1,137	189.5	NA	39	137	3.5	NA	NA	NA	1,274	NA	NA	NA
1975	13	3,026	232.8	NA	118	717	6.1	NA	NA	NA	3,743	NA	NA	NA
1976	19	3,876	204.0	NA	203	1,925	9.5	NA	NA	NA	5,801	NA	NA	NA
1977	52	4,743	91.2	NA	297	5,569	18.8	NA	NA	NA	10,312	NA	NA	NA
1978	69	5,872	85.1	NA	204	4,988	24.5	NA	NA	NA	10,860	NA	396	840
1979	84	8,394	100.0	NA	257	5,856	22.8	NA	NA	NA	14,251	NA	290	855
1980	79	12,233	154.8	NA	250	7,165	28.7	NA	NA	NA	19,398	NA	235	1,115
1981	75	8,677	115.7	NA	263	11,456	43.6	NA	NA	NA	21,133	NA	196	771
1982	61	7,476	122.6	NA	248	11,145	44.9	NA	NA	NA	18,621	NA	418	455
1983	55	4,853	88.2	NA	179	11,975	66.9	NA	NA	NA	16,828	NA	511	159
1984	48	4,479	93.3	NA	206	11,939	58.0	NA	773	NA	17,191	NA	621	348
1985	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1986	22	3,751	170.5	^R 2.30	87	1,111	12.8	^R 18.30	4,498	NA	9,360	^R 6.14	473	224
1987	12	3,157	263.1	^R 2.18	50	957	19.1	^R 13.50	3,155	NA	7,269	^R 4.82	691	182
1988	8	3,326	415.8	2.24	45	732	16.2	^R 14.88	4,116	NA	8,174	^R 4.56	814	158
1989	10	4,283	428.3	2.60	36	1,989	55.3	^R 11.74	5,209	^R 17.76	11,482	^R 10.92	1,233	461
1990	12	3,645	303.8	2.90	41	2,527	61.6	7.68	5,237	15.74	11,409	^R 9.86	1,562	245
1991	16	5,585	349.0	2.90	41	989	24.1	11.94	1	31.94	6,574	4.26	1,543	332
1992	16	6,187	386.7	^R 2.50	34	897	26.4	10.96	2	75.66	7,086	3.58	1,650	316
1993	13	6,025	463.5	^R 2.80	33	931	28.2	^R 11.74	12	^R 22.12	6,968	3.96	2,039	411
1994	16	6,823	426.0	^R 2.54	31	803	26.0	^R 13.54	2	^R 177.00	7,627	^R 3.74	1,815	405
1995	14	6,813	487.0	^R 2.32	26	840	32.0	10.48	13	53.26	7,666	^R 3.30	2,037	530
1996	14	6,821	487.0	2.67	19	785	41.0	14.48	10	18.75	7,616	3.91	1,930	454
1997	13	7,524	579.0	2.60	21	606	29.0	15.17	7	25.00	8,138	3.56	2,102	379
1998	12	7,292	607.0	2.83	19	443	23.0	15.17	21	53.21	7,756	3.66	2,206	360

¹ Low-temperature collectors are solar thermal collectors that generally operate at temperatures below 110 degrees Fahrenheit.

² Medium-temperature collectors are solar thermal collectors that generally operate in the temperature range of 140 degrees Fahrenheit to 180 degrees Fahrenheit but can also operate at temperatures as low as 110 degrees Fahrenheit. Special collectors are included in this category. Special collectors are evacuated tube collectors or concentrating (focusing) collectors. They operate in the temperature range from just above ambient temperature (low concentration for pool heating) to several hundred degrees Fahrenheit (high concentration for air conditioning and specialized industrial processes).

³ High-temperature collectors are solar thermal collectors that generally operate at temperatures above 180 degrees Fahrenheit.

⁴ Total shipments as reported by respondents include all domestic and export shipments and may

include imports that subsequently were shipped to domestic or to foreign customers.

⁵ Prices, in nominal dollars, equal shipment value divided by quantity shipped. Value includes charges for advertising and warranties. Excluded are excise taxes and the cost of freight or transportation for the shipments.

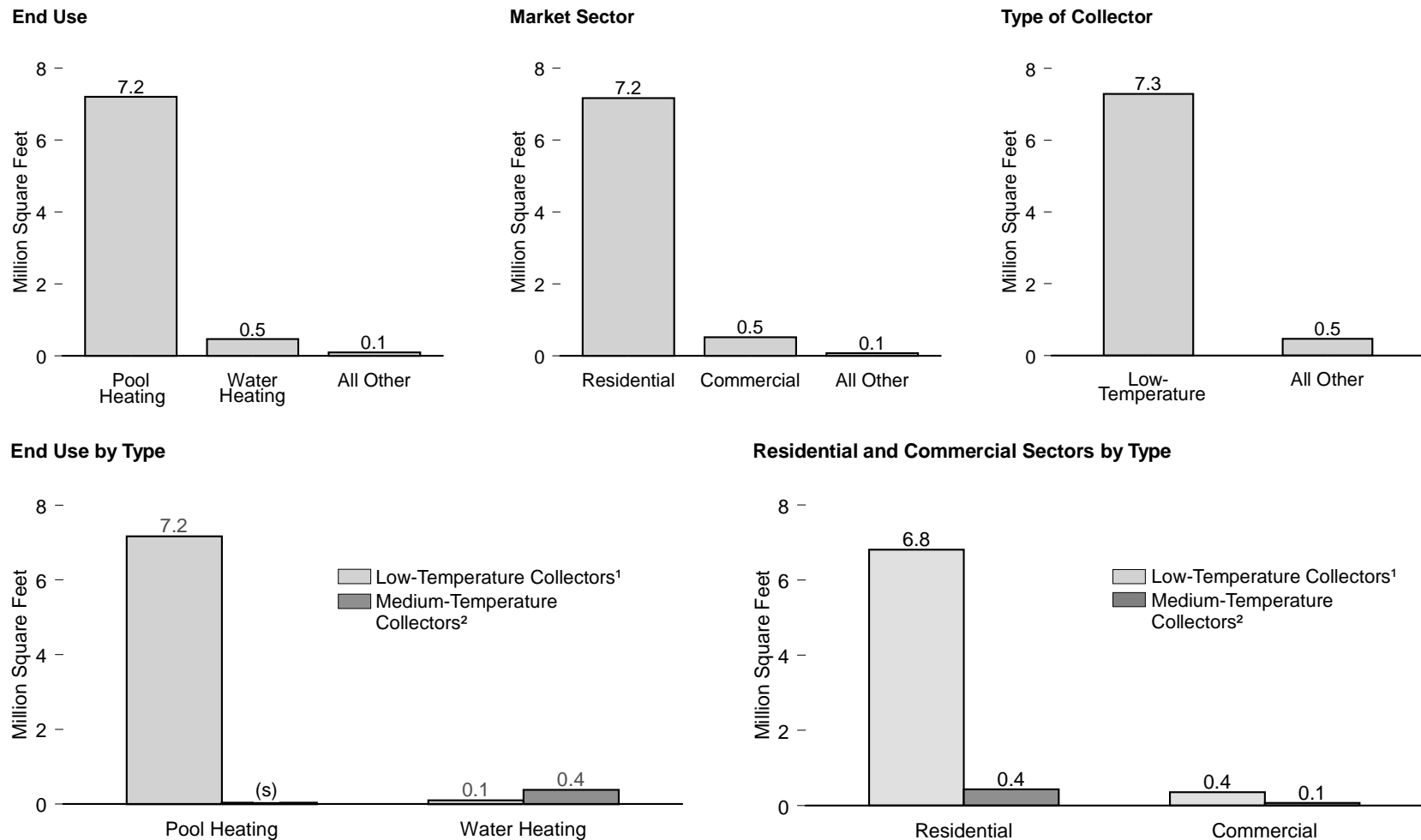
R=Revised. NA=Not available.

Notes: • Manufacturers producing more than one type of collector are accounted for in both groups. • No data are available for 1985. • High-temperature collector shipments were dominated by one manufacturer.

Web Page: <http://www.eia.doe.gov/fuelrenewable.html>.

Sources: • 1974-1992—Energy Information Administration (EIA), *Solar Collector Manufacturing Activity*, annual reports. • 1993 forward—EIA, *Renewable Energy Annual*, annual reports.

Figure 10.6 Solar Thermal Collector Shipments by End Use, Market Sector, and Type, 1998



¹ Collectors that generally operate at temperatures below 110 degrees Fahrenheit.

² Collectors that generally operate in the temperature range of 140 degrees Fahrenheit to 180 degrees Fahrenheit but can also operate at temperatures as low as 110 degrees Fahrenheit.

(s)=Less than 0.05 million square feet.

Source: Table 10.6.

Table 10.6 Solar Thermal Collector Shipments by End Use, Market Sector, and Type, 1998
(Thousand Square Feet)

End Use	Low-Temperature Collectors ¹	Medium-Temperature Collectors ²	High-Temperature Collectors ³	Total
End-Use Total	7,285	443	21	⁴ 7,757
Pool Heating	7,164	37	0	7,201
Water Heating	60	385	18	463
Space Heating	53	14	0	67
Space Cooling	0	0	0	0
Combined Space and Water Heating	8	7	(s)	15
Process Heating	0	0	0	0
Electricity Generation	0	0	2	⁴ 10
Other ⁵	(s)	0	1	1
Market Sector Total	7,285	443	21	⁴ 7,757
Residential	6,810	355	0	7,165
Commercial	429	70	18	517
Industrial	44	18	0	62
Electric Utility	0	0	2	⁴ 10
Other ⁶	2	0	1	3

¹ Low-temperature collectors are solar thermal collectors that generally operate at temperatures below 110 degrees Fahrenheit.

² Medium-temperature collectors are solar thermal collectors that generally operate in the temperature range of 140 degrees Fahrenheit to 180 degrees Fahrenheit but can also operate at temperatures as low as 110 degrees Fahrenheit. Special collectors are included in this category. Special collectors are evacuated tube collectors or concentrating (focusing) collectors. They operate in the temperature range from just above ambient temperature (low concentration for pool heating) to several hundred degrees Fahrenheit (high concentration for air conditioning and specialized industrial processes).

³ High-temperature collectors are solar thermal collectors that generally operate at temperatures above 180 degrees Fahrenheit. These are Parabolic dish/trough collectors used primarily by independent power producers to generate electricity for the electric grid.

⁴ Totals include other types of collectors not shown.

⁵ "Other" includes shipments of solar thermal collectors for other uses, such as cooking foods, water pumping, water purification, desalinization, distilling, etc.

⁶ "Other" includes shipments of solar thermal collectors to other sectors, such as government, including the military but excluding space applications.

(s)=Less than 0.5 thousand square feet.

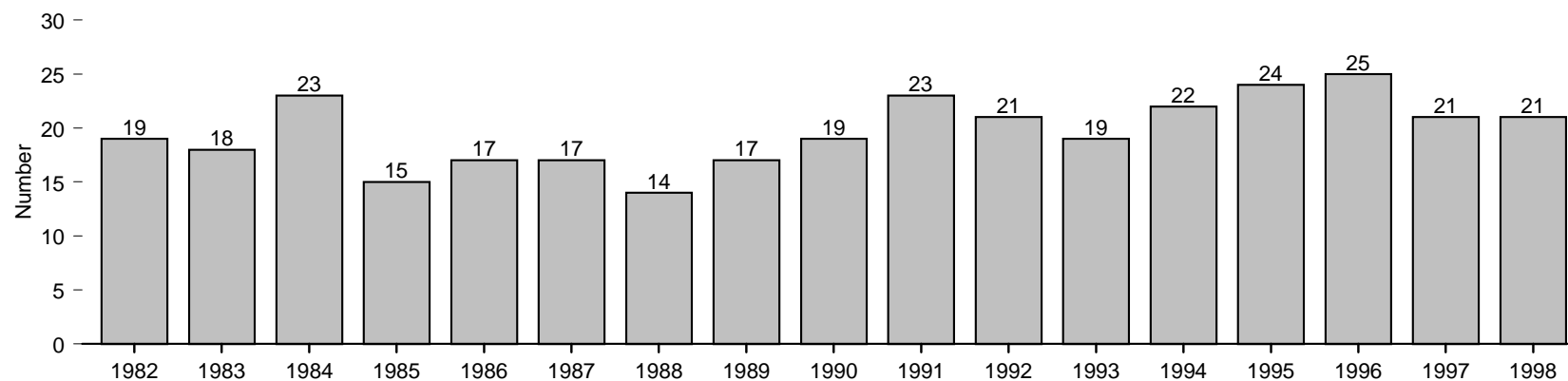
Notes: • Data represent shipments from U.S. manufacturers only. • Totals may not equal sum of components due to independent rounding.

Web Page: <http://www.eia.doe.gov/fuelrenewable.html>.

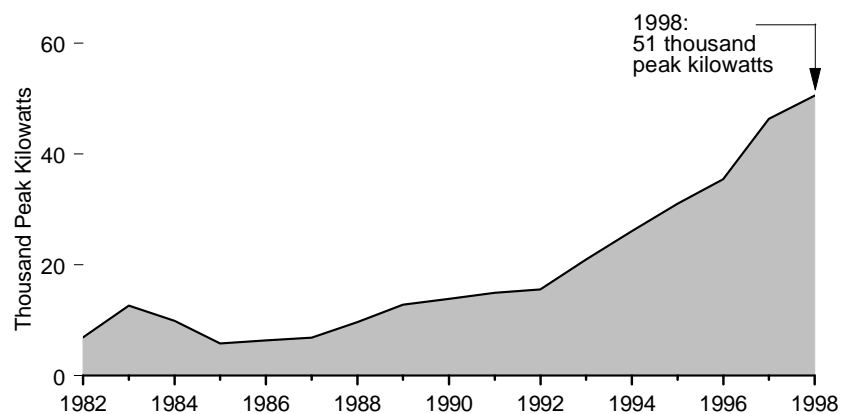
Source: Energy Information Administration, *Renewable Energy Annual 1999* (March 2000), Table 19.

Figure 10.7 Photovoltaic Cell and Module Shipments and Trade

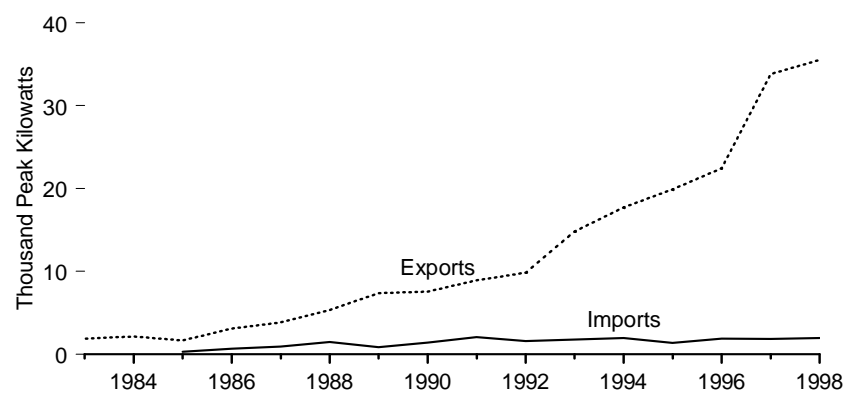
Number of U.S. Companies Reporting Shipments, 1982-1998



Total Shipments, 1982-1998



Trade, 1983-1998



Note: Because vertical scales differ, graphs should not be compared.

Source: Table 10.7.

Table 10.7 Photovoltaic Cell and Module Shipments by Type, Price, and Trade, 1982-1998

Year	Number of U.S. Companies Reporting Shipments	Shipments			Imports	Exports	Prices ¹	
		Crystalline Silicon	Thin-Film Silicon	Total ²			Modules	Cells
1982	19	NA	NA	6,897	NA	NA	NA	NA
1983	18	NA	NA	12,620	NA	1,903	NA	NA
1984	23	NA	NA	9,912	NA	2,153	NA	NA
1985	15	5,461	303	5,769	285	1,670	NA	NA
1986	17	5,806	516	6,333	678	3,109	NA	NA
1987	17	5,613	1,230	6,850	921	3,821	NA	NA
1988	14	7,364	1,895	9,676	1,453	5,358	NA	NA
1989	17	10,747	1,628	12,825	826	7,363	5.14	^R 3.08
1990	³ 19	12,492	1,321	³ 13,837	1,398	7,544	5.69	3.84
1991	23	14,205	723	14,939	2,059	8,905	6.12	4.08
1992	21	14,457	1,075	15,583	1,602	9,823	6.11	3.21
1993	19	20,146	782	20,951	1,767	14,814	5.24	5.23
1994	22	24,785	1,061	26,077	1,960	17,714	4.46	2.97
1995	24	29,740	1,266	31,059	1,337	19,871	4.56	2.53
1996	25	33,996	1,445	35,464	1,864	22,448	4.09	2.80
1997	21	44,314	1,886	46,354	1,853	33,793	4.16	2.78
1998	21	47,186	3,318	50,562	1,931	35,493	3.94	3.15

¹ Prices, in nominal dollars, equal shipment value divided by quantity shipped. Value includes charges for advertising and warranties. Excluded are excise taxes and the cost of freight or transportation for the shipments.

² Total shipments include all types of photovoltaic cells and modules (single-crystal silicon, cast silicon, ribbon silicon, thin-film silicon, and concentrator silicon) and internationally traded cells and modules. Shipments of cells and modules for space and satellite applications are not included.

³ Data were imputed for one nonrespondent who exited the industry during 1990.

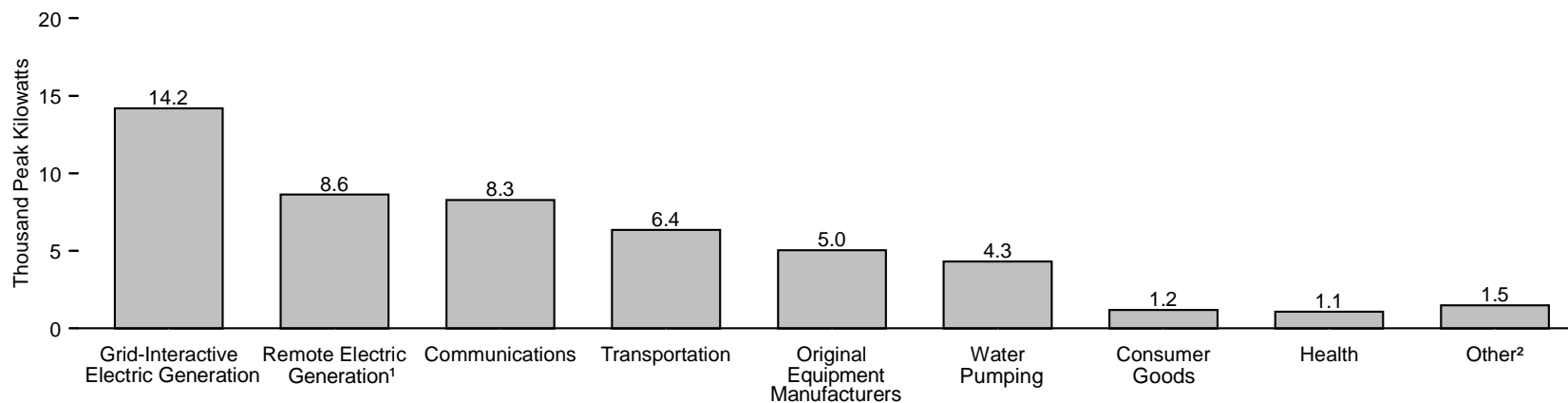
R=Revised data. NA=Not available.

Web Page: <http://www.eia.doe.gov/fuelrenewable.html>.

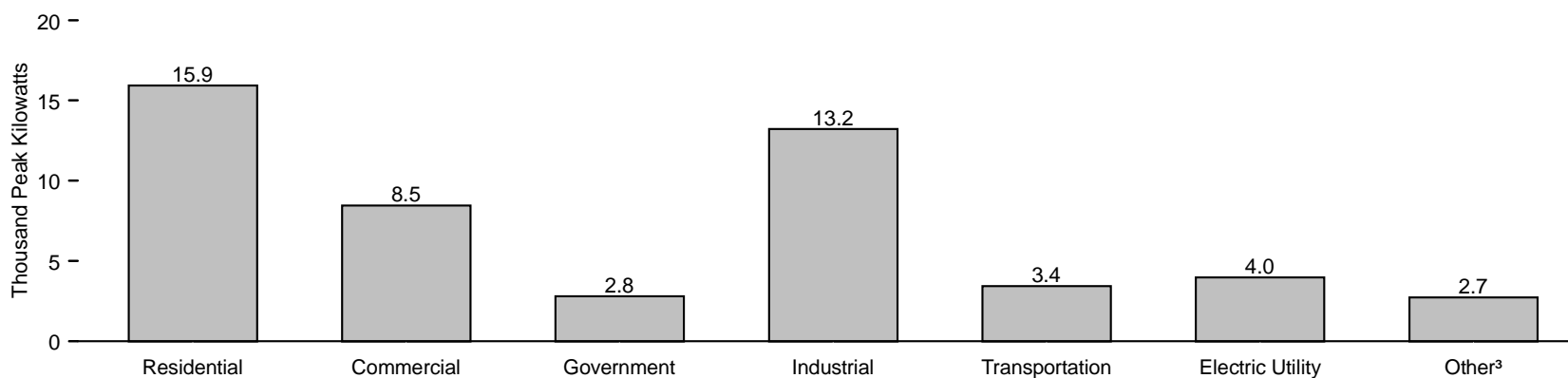
Sources: • 1982-1992—Energy Information Administration (EIA), *Solar Collector Manufacturing Activity*, annual reports. • 1993 forward—EIA, *Renewable Energy Annual*, annual reports.

Figure 10.8 Photovoltaic Cell and Module Shipments by End Use and Market Sector, 1998

By End Use



By Market Sector



¹ Units designed for installations that are not grid-interactive.

² Represents such applications as cooking food, desalinization, and distilling.

³ Shipments to foreign governments and for specialty purposes.

Source: Table 10.8.

Table 10.8 Photovoltaic Cell and Module Shipments by End Use and Market Sector, 1989-1998

	End Use									Market Sector							
Year	Commu- nications	Consumer Goods	Electric Generation ¹		Health	Original Equip- ment Manu- facturers ²	Trans- portation	Water Pumping	Other ³	Resi- dential	Com- mercial	Gov- ernment	Indus- trial	Trans- portation	Electric Utility	Other ⁴	Total
			Grid- Inter- active	Remote													
Amount Shipped (peak kilowatts)																	
1989	2,590	2,788	1,251	2,620	5	1,595	1,196	711	69	1,439	3,850	1,077	3,993	1,130	785	551	12,825
1990	4,340	2,484	469	3,097	5	1,119	1,069	1,014	240	1,701	6,086	1,002	2,817	974	826	432	13,837
1991	3,538	3,312	856	3,594	61	1,315	1,523	729	13	3,624	3,345	815	3,947	1,555	1,275	377	14,939
1992	3,717	2,566	1,227	4,238	67	828	1,602	809	530	4,154	2,386	1,063	4,279	1,673	1,553	477	15,583
1993	3,846	946	1,096	5,761	674	2,023	4,238	2,294	74	5,237	4,115	1,325	5,352	2,564	1,503	856	20,951
1994	5,570	3,239	2,296	9,253	79	1,849	2,128	1,410	254	6,632	5,429	2,114	6,855	2,174	2,364	510	26,077
1995	5,154	1,025	4,585	8,233	776	3,188	4,203	2,727	1,170	6,272	8,100	2,000	7,198	2,383	3,759	1,347	31,059
1996	6,041	1,063	4,844	10,884	977	2,410	5,196	3,261	789	8,475	5,176	3,126	8,300	3,995	4,753	1,639	35,464
1997	7,383	347	8,273	8,630	1,303	5,245	6,705	3,783	4,684	10,993	8,111	3,909	11,748	3,574	5,651	2,367	46,354
1998	8,280	1,198	14,193	8,634	1,061	5,044	6,356	4,306	1,491	15,936	8,460	2,808	13,232	3,440	3,965	2,720	50,562
Percent of Total																	
1989	20.2	21.7	9.8	20.4	(s)	12.4	9.3	5.5	0.5	11.2	30.0	8.4	31.1	8.8	6.1	4.3	100.0
1990	31.4	18.0	3.4	22.4	(s)	8.1	7.7	7.3	1.7	12.3	44.0	7.2	20.4	7.0	6.0	3.1	100.0
1991	23.7	22.2	5.7	24.1	0.4	8.8	10.2	4.9	0.1	24.3	22.4	5.5	26.4	10.4	8.5	2.5	100.0
1992	23.9	16.5	7.9	27.2	0.4	5.3	10.3	5.2	3.4	26.7	15.3	6.8	27.5	10.7	10.0	3.1	100.0
1993	18.4	4.5	5.2	27.5	3.2	9.7	20.2	10.9	0.4	25.0	19.6	6.3	25.5	12.2	7.2	4.1	100.0
1994	21.4	12.4	8.8	35.5	0.3	7.1	8.2	5.4	1.0	25.4	20.8	8.1	26.3	8.3	9.1	2.0	100.0
1995	16.6	3.3	14.8	26.5	2.5	10.3	13.5	8.8	3.8	20.2	26.1	6.4	23.2	7.7	12.1	4.3	100.0
1996	17.0	3.0	13.7	30.7	2.8	6.8	14.7	9.2	2.2	23.9	14.6	8.8	23.4	11.3	13.4	4.6	100.0
1997	15.9	0.7	17.8	18.6	2.8	11.3	14.5	8.2	10.1	23.7	17.5	8.4	25.3	7.7	12.2	5.1	100.0
1998	16.4	2.4	28.1	17.1	2.1	10.0	12.6	8.5	2.9	31.5	16.7	5.6	26.2	6.8	7.8	5.4	100.0

¹ Grid-interactive means connection to the electrical distribution system; remote means electricity, for general use, that does not interact with the electrical distribution system, such as at an isolated residential site or mobile home. The other end uses in this table also include electricity generation but only for the specific use cited.

² Original Equipment Manufacturers are non-photovoltaic manufacturers that combine photovoltaic technology into existing or newly developed product lines.

³ Represents such applications as cooking food, desalinization, and distilling.

⁴ Shipments to foreign governments and for specialty purposes.

(s)=Less than 0.05 percent.

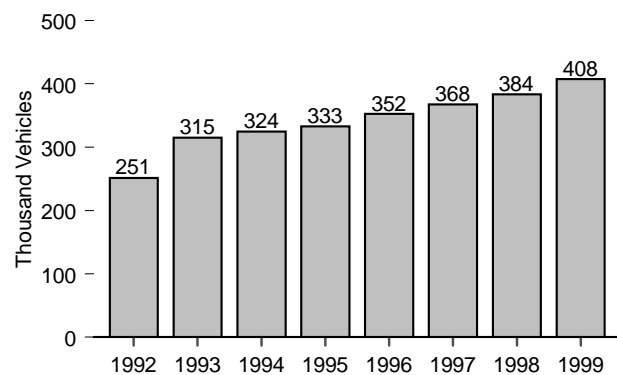
Note: Totals may not equal sum of components due to independent rounding.

Web Page: <http://www.eia.doe.gov/fuelrenewable.html>.

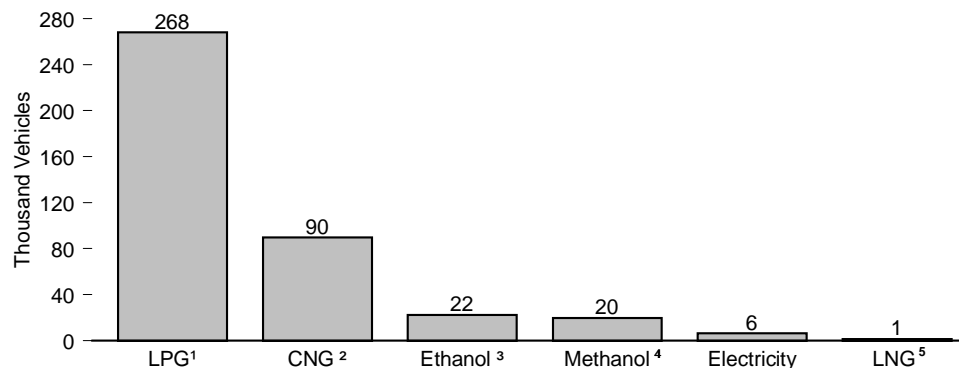
Sources: • 1989-1992—Energy Information Administration (EIA), *Solar Collector Manufacturing Activity*, annual reports. • 1993 forward—EIA, *Renewable Energy Annual*, annual reports.

Figure 10.9 Alternative-Fueled Vehicles and Fuel Consumption by Type

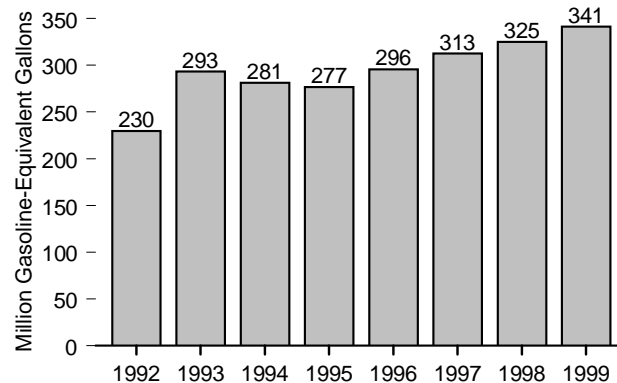
Vehicles in Use, 1992-1999



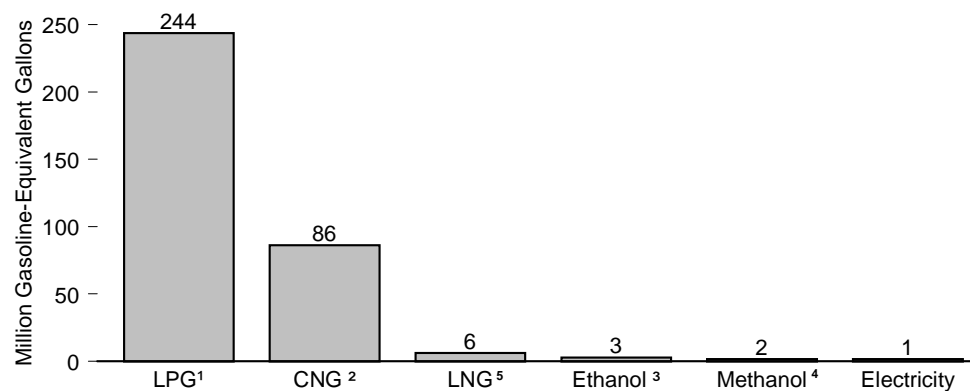
Vehicles in Use by Fuel Type, 1999



Fuel Consumption, 1992-1999



Fuel Consumption by Type, 1999



¹ Liquefied petroleum gases.

² Compressed natural gas.

³ Ethanol, 85 percent and ethanol, 95 percent.

⁴ Methanol, 85 percent, and methanol, neat.

⁵ Liquefied natural gas.

Note: Because vertical scales differ, graphs should not be compared.

Source: Table 10.9.

Table 10.9 Alternative-Fueled Vehicles and Fuel Consumption by Type, 1992-1999

Year	Liquefied Petroleum Gases ¹	Compressed Natural Gas	Liquefied Natural Gas	Methanol, 85 Percent ²	Methanol, Neat	Ethanol, 85 Percent ²	Ethanol, 95 Percent ²	Electricity	Total
Estimated Number of Vehicles in Use									
1992	221,000	23,191	90	4,850	404	172	38	1,607	251,352
1993	269,000	32,714	299	10,263	414	441	27	1,690	314,848
1994	264,000	41,227	484	15,484	415	605	33	2,224	324,472
1995	259,000	50,218	603	18,319	386	1,527	136	2,860	333,049
1996	263,000	60,144	663	20,265	172	4,536	361	3,280	352,421
1997	263,000	^R 68,571	813	21,040	172	9,130	347	4,453	^R 367,526
1998	^R 266,000	^R 78,782	^R 1,172	^R 19,648	^R 200	^R 12,788	14	^R 5,243	^R 383,847
1999 ^P	268,000	89,633	1,422	19,497	200	22,359	14	6,417	407,542
Estimated Fuel Consumption (Thousand Gasoline-Equivalent Gallons)									
1992	208,142	16,823	585	1,069	2,547	21	85	359	229,631
1993	264,655	21,603	1,901	1,593	3,166	48	80	288	293,334
1994	248,467	24,160	2,345	2,340	3,190	80	140	430	281,152
1995	232,701	35,162	2,759	2,023	2,150	190	995	663	276,643
1996	239,158	46,923	3,247	1,775	347	694	2,699	773	295,616
1997	238,356	^R 65,192	3,714	1,554	347	1,280	1,136	1,010	^R 312,589
1998	^R 241,583	^R 73,251	^R 5,343	^R 1,212	^R 449	^R 1,727	59	^R 1,202	^R 324,826
1999 ^P	243,648	86,073	6,062	1,108	449	2,489	59	1,458	341,346

¹ Vehicles in use represent lower bound estimates, rounded to the nearest thousand.

² Remaining portion is motor gasoline.

R=Revised data. P=Preliminary data.

Note: Totals may not equal sum of components due to independent rounding.

Source: Web Page: <http://www.eia.doe.gov/fuelrenewable.html>.

